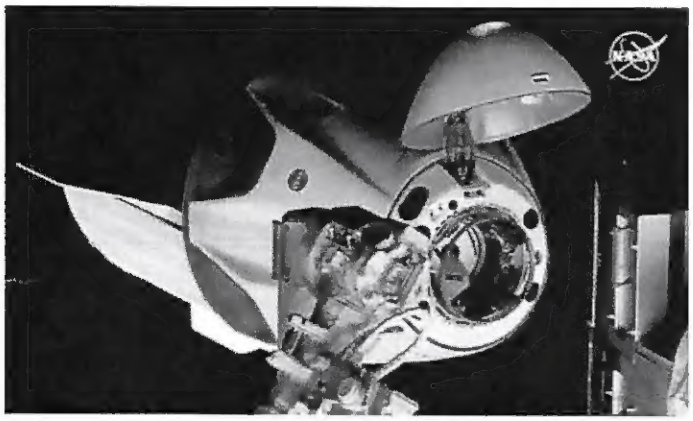
SRI International's Role in Commercial Space Transportation: Designing NASA's Business Partnership Model for Commercializing Space

By Paul Masson, Managing Director, StarNet LLC

A privately owned space capsule called *Dragon* operated by Elon Musk's SpaceX Corporation docked at the International Space Station on May 31, 2020. This event was hailed in the US media as "the first time a privately built and owned spacecraft carried astronauts to the space station in its more than 20 years of existence," with the NASA administrator declaring, "NASA is not going to purchase, own and operate rockets and capsules the way we used to...we're going to partner with commercial industry."[1]*



SpaceX's Crew Dragon Demo-2 *spacecraft, with NASA astronauts Bob Behnken and Doug Hurley onboard, approaching docking with International Space Station on May 31, 2020. Photo credit: NASA.*

This change is the outcome of a federal policy from the 1980s to transition from government-owned to commercially operated space transportation and services. A key element of this transition was conceived in the International Building courtyard in the spring of 1983, when a team of SRI professionals led by Jim Wilhelm was brainstorming solutions to NASA's industry outreach and came up with the recommendation to adopt public-private partnerships to implement the transition. Beyond SRI's institutional role, a small network of SRI alumni were hired by NASA to operationalize the public-private partnership mechanisms that were eventually used to build the US commercial spaceflight industry.

*Numbered footnotes are at the end of the article.

US Space Policy: From Government Owned to Public-Private Partnerships

The American moon landings had marked the successful conclusion of a decade-long quest to lead the world in space launch and operations capability. The US effort was led by NASA, which was organized as a core of civil servants at field centers that coordinated an army of private sector contractors into a series of mission programs. The first program, Mercury, was designed to determine whether a human could survive in space; the second program, Gemini, was designed to determine whether two astronauts could maneuver in space and link up with orbiting vehicles; the third program, Apollo, was designed to fly astronauts to the moon for exploration and return them safely to earth.[2]

Congress equipped NASA with a massive budget and expansive authority to enter into any form of business agreement necessary to achieve the agency's mission objectives. The authority, broadly called Space Act Authority, contained unusual provisions, including "enter into and perform such contracts, leases, cooperative agreements and other transactions as may be necessary in the conduct of its work."[3] This broad authority enabled NASA to build the network of scientists, technologists, and contractors to design and implement each mission.

The successful moon landing achieved two major goals for the United States, first to undertake a peaceful exploratory mission and second to demonstrate US rocket capability for cross-global delivery. With accomplishment of these two goals and the nation moving into political disputes over the economy, funding NASA's network of for-profit contractors and salaried researchers was no longer sustainable.

Rather, the creation of a space shuttle capable of undertaking a variety of missions was adopted for NASA. The idea was straightforward: create a multipurpose space transportation vehicle for exploration, research, and in-space servicing. Both development and operations costs exceeded projections, however, leaving subsequent administrations with the decision of whether to continue or further scale back US space transportation capabilities.

One solution to the high cost of space exploration was to spin off NASA's space flight and operations capabilities to commercial organizations, as had been done with the individual technology transfer spinoffs. NASA had a long history of small projects with private sector organizations that transferred knowledge and expertise for communications and weather observation satellites. The commercial spinoff

idea was adopted as policy under the Carter administration, which issued an update for space policy that included the guidance, "The United States will encourage domestic commercial exploitation of space capabilities and systems for economic benefit to promote the technological position of the United States."[4]

The Reagan administration decided to expand on this policy by directing NASA to define and implement "space commercialization." In a July 4, 1982, speech, President Reagan promised to "provide a climate conducive to expanded private sector investment in civil space activities."[5] Throughout the remainder of 1982, Reagan administration advisors continued to formulate directives for policies and programs that resulted in NASA offering to lease space launch vehicles and engage in cost-shared technology development for "the first successful private launch in the United States."[6] In 1983, the Reagan administration began its next step toward implementation of the new policy when NASA drew up guidelines to establish a Space Commercialization Task Force. The task force members sought out national specialists in technology utilization and commercialization. The search led them to SRI's Technology and Innovation Management Center, with a project team led by Jim Wilhelm working with key colleagues David Keaton and Marcelo Hoffmann.

Solutions Sought: SRI Retained to Advise NASA

NASA's Space Commercialization Task Force had a mandate to shift from the agency's network of cost-plus-markup contractors to a model that supported the emergence of a commercial space transportation and services industry. This type of total transformation had never been attempted in US history. While the government had been an investor or anchor client in the emerging railway, telegraph, and aviation industries, it had not had to convert an entire government-run function into one driven by commercial market incentives.

NASA Administrator James M. Beggs's mandate to the task force was daunting: develop "an agency-wide policy and integrated program plan for enhancing NASA's ability to encourage and be responsive to commercialization endeavors. The Task Force will identify specific commercialization initiatives which should be taken to lessen the barriers and increase incentives for private sector investment and involvement in civil space activities."[7]

The task force managers decided to create an outreach program to encourage private companies' involvement in civil space activities, including direct investments and private operations.[8] The outreach program had four objectives:

1. To raise interest in the US private sector about space commercialization.
2. To inform the private sector about relevant space commercialization opportunities, endeavor agreement options, and incentives.
3. To establish a two-way communication channel between the private sector and NASA for all space commercialization matters.
4. To guide companies to space commercialization commitments and investments via appropriate endeavor agreement options.

The mandate from Administrator Beggs had a new feature for NASA: a requirement that the outreach include connections with companies, entrepreneurs, venture capitalists, finance companies, and insurance companies to increase commercial adoption and incentivize investment.[9]

The Space Commercialization Task Force compiled NASA's first inventory of agreements with private sector companies for possible space commercialization and found 10 different approaches used through five different offices, many with different principles and business practices. The task force, with SRI's analyses, drew two strategic conclusions:

- Coordination and consistency—NASA needed to coordinate the multiple business mechanisms through one unit following an integrated strategy.
- New business mechanisms—NASA needed new mechanisms to incentivize private sector investment. The task force recommended:
  - Multi-company research groups
  - Cost or intellectual property (IP)-sharing projects.

The strategic conclusions raised a further question: how to design, build, and implement NASA capabilities for both a business unit focused on commercialization *and* the multi-company research groups or cost-shared projects. To answer these questions, SRI invited the NASA task force to Menlo Park for brainstorming.

One Proposed Solution: Adopt R&D Limited Partnerships

An SRI team of 18 specialists brainstormed with the NASA managers for a week to generate outreach mechanisms along with details for implementation. The meetings were

held during the spring transition to summer, floating between the I Building conference rooms and the courtyard. Group sessions led to small breakout groups and further brainstorming. A long list of commercialization outreach tools was generated but with a short list of ones that would link to private companies and investors.

I joined the meetings as a financing specialist from the Corporate Financial Services (CFS) consulting unit. The best idea from the field of finance was to use R&D partnerships between NASA and private companies to transfer and commercialize technology, because that mechanism automatically attracted entrepreneurs, early-stage capital, and institutional finance. The task force members expressed interest in the idea but wanted details: What is an R&D partnership, how would it be organized, how would it attract private capital, and would it work given national politics?

Beyond the Concept: Designing a Cost- and IP-Shared R&D Partnership

The designing of a public-private R&D partnership fell to me, and I immediately turned to colleagues from the CFS consulting unit. I spent time talking with Alan Biller, John Cox, and Syed Shariq along with Pat Sullivan in the Management Consulting Group. After a careful allocation of sold time and incentives, such as lunch tickets during ice cream Fridays, I collected the group wisdom and generated a basic description for R&D public-private partnerships that eventually made its way to NASA's new commercialization unit, Code C.

A by-product of this teaming was a knowledge relationship that would last after we left SRI. Three of us—Pat Sullivan, Syed Shariq, and I—eventually reconnected under NASA funding to advocate for, design, and implement the partnership mechanisms that were used by SpaceX, Northrop Grumman, and other emerging space commercialization companies.

NASA Implementation: Team at Ames Begins Legal Research, Forms Program

NASA Ames, a regional research center in northern California, adopted the recommendation to form multi-client research groups along with R&D limited partnerships. Ames senior managers solicited ideas from their personnel on ways to implement R&D partnerships. Ames Chief Counsel J. Henry Glazer formed a team of legal specialists and technologists under the concept of "Joint Enterprises" to identify the legal authority, mechanisms, and implementation for R&D partnerships that went beyond the existing Joint Endeavor Agreements pioneered by McDonnell Douglas and NASA in 1983. By 1986, Glazer had formed his team and added now former SRI employee Syed Shariq. The Ames team completed a legal analysis concluding that R&D partnerships could be implemented in multiple forms, using NASA's existing Space Act Authority similarly to the Joint Endeavor Agreements.[10]

The Ames managers moved to implement the concept through the San Francisco State University Foundation. The idea was to create a nonprofit program, the Joint Enterprise Institute, that would form both R&D partnerships and multi-client research programs centered around universities. The Joint Enterprise Institute became a three-year NASA Joint Sponsored Research Program (JSRP) within the NASA Technology Utilization organization.[11] The JSRP was moved from the Joint Enterprise Institute to a nonprofit called American Technology Initiative (AmTech) that was formed in July 1989 and funded by a three-year cooperative agreement between NASA Ames Research Center and the AmTech board. NASA assigned Shariq to AmTech to act as the initial chief executive officer with primary responsibility to lead the policy advocacy for the JSRP within NASA.

SRI Alumni Reconvene: NASA Hires SRI Alumni

Two other members of the SRI knowledge network had left the institute and joined the MAC Group consulting organization. Pat Sullivan had joined MAC and done a strategy for the Ames Research Center, which included an action to test new mechanisms of incentivizing investment in space commercialization. I joined MAC as a general management consultant in 1988 and became a pro bono advisor to Shariq on the formation of the Joint Sponsored Research Program and AmTech.

I joined Shariq at AmTech for three years, he advocating the concept of multi-party R&D within NASA and I building the JSRP business agreement process and implementation operations. I was teamed with two attorneys who had been interns at NASA Ames, David Lloyd, who handled the legal and operational elements of the AmTech relationship with NASA, and Karen Robbins, who researched the law, developed IP guidelines, and drafted agreements under the business model developed to implement the JSRP. The program's partnership models, legal research, and operational implementation guidelines were incorporated into NASA's management system by the late 1990s.[12]

New Era: Commercial Orbital Space Transport

The NASA JSRP was adopted by NASA's Commercial Orbital Transportation Services (COTS) initiative, which coordinated private companies' development of vehicles for the delivery of crew and cargo to the International Space Station. The program was announced on January 18, 2006, and successfully flew all cargo demonstration flights by September 2013.

NASA signed agreements with SpaceX and Rocketplane Kistler (RpK) in 2006 but later terminated the agreement with RpK because of insufficient private funding. NASA signed an agreement with Orbital Sciences in 2008.

NASA's final report considered the COTS program an unqualified success and a model for future public-private collaboration. Compared with traditional costs-plus contracts used by NASA, such as the $12 billion Orion (spacecraft) contract, the unprecedented efficiency of the $800 million COTS investment resulted in "two new U.S. medium-class launch vehicles and two automated cargo spacecraft."[13]

Epilogue: Complete Experience of a Lifetime

The privately owned spaceship VSS *Unity*, launched from the New Mexico spaceport on July 11, 2021, carried Virgin Galactic employees, including founder Sir Richard Branson, to an altitude similar to that of Alan Shepard's 60 years earlier. The vehicle was designed by Scaled Composites and drew technology from a half-dozen public-private partnerships to design, test, and launch the unique spacecraft. Virgin Galactic, which had signed its first partnership with NASA in 2007, inked additional partnerships with NASA in 2020 to develop a next generation of high-speed vehicles for commercial use. Branson tweeted of the trip, "It's the complete experience of a lifetime."[14]

The VSS Unity *starting its propulsion after being disconnected from the carrier aircraft. Photo credit: Virgin Galactic.*

Another privately owned spacecraft called *New Shepard* launched from a Texas spaceport nine days later, on July 20, aboard a Blue Origin rocket that carried founder Jeff Bezos and three other crew members including "the oldest and youngest people to ever have flown in space."[15] The *New Shepard* rocket engine had been developed through a public-private partnership between NASA and Blue Origin, using the same authority adopted by NASA's Joint Sponsored Research Program.

Blue Origin's launch of New Shepard *on July 20 in West Texas. Photo credit: Blue Origin.*

Both founders tweeted the experiences were the confirmation of lifelong dreams. Those experiences were also the confirmation of an idea posited nearly 40 years earlier at SRI.

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1. "SpaceX's Historic Encore: Astronauts Arrive at Space Station," Associated Press, May 30, 2020; accessed July 8, 2021.
2. Roger Bilstein, *Orders of Magnitude: A History of the NACA and NASA, 1915 to 1990*, NASA History Series, NASA SP-4406.
3. NASA enabling legislation, subsection 203(C).
4. White House Fact Sheet, June, 1978; in Michael A. G. Michaud, *Reaching for the High Frontier*, Ch. 12, Praeger Publishers, 1986.
5. National Space Policy, Civil Space Program, Private Sector Participation (Sec. 3.4.B), NSDD-42, July 4, 1982, NASA Historical Reference Collection; accessed July 23, 2021.
6. "Origins of the Commercial Space Industry," US Department of Commerce, Federal Aviation Administration, p. 1; retrieved July 23, 2021.
7. SRI International, *NASA Space Commercialization, Outreach Program Plan*, NASA Contract NASW-3823, January 31, 1984, p. 1.
8. Ibid., p. 1.
9. Ibid., p. 3.

10. J. Henry Glazer, "The Expanded Use of Space Act Authority to Accelerate Space Commercialization Through Advanced Joint Enterprises Between Federal and Non-Federal Constituencies", *Rutgers Computer and Technology Law Journal*, Vol. 12, No. 2, 1987.

11. *Joint Sponsored Research Program, Space Technology Innovation*, NASA Office of Space Access and Technology, Vol. 3, No. 6, November/December 1995, p. 7.

12. NASA Advisory Implementing Instructions, NAII 1050-1, Sec. 1.6, Funded Agreements, Effective December 30, 1998.

13. "NASA Releases COTS Final Report" (press release), NASA 2014-06-03; accessed July 14, 2021.

14. "Richard Branson Reaches Edge of Space: It's the complete experience of a lifetime," CNBC News, July 11, 2021; accessed July 12, 2021.

15. "Jeff Bezos Reaches Space on Blue Origin's First Crewed Launch," CNBC News, July 20, 2021; accessed July 21, 2021.

The Renter

By William Grindley

In 1995, we rented the top two floors of the former water tower at our 150-year-old Atherton home (now called The Fennwood Estate) to a nice young man who was going to Stanford Graduate School in chemistry. Nearly every morning, I would meet him in our parking lot with my jumper cables to help him get his ancient BMW running. It was not difficult for me, as I had left SRI and worked from my home office (a pioneer in that). He was always polite and courteous.

After six to eight months, he told us he wasn't going to continue at Stanford. Rather, he and a friend were starting a company to put maps on the web and asked if we wished to invest. The minimum investment exceeded what my wife and I thought we could "stretch" for at the time. We declined. But my wife told him of a friend who had made millions of dollars by starting semiconductor companies and gave our renter the name and telephone number. (Our friend invested and three years later got back 20 times his original principal.)

Some months later, our renter left. We haven't seen him since. Our daughter, however, now a governess for a wealthy family, saw him recently when he attended a social function at her employer's home. She reminded him that he had lived in our tower. He remembered and said he wanted to thank her parents for being kind to him. That renter was Elon Musk!

While that experience and $3.75 will get you a Grande Latte at Starbucks, it was encouraging to our family that his courtesy towards our daughter evidenced a kindness and some level of humility that Elon is not always recognized as having.

Because we know the "human side" of Elon Musk, and having lived 50 years in the world's center of innovation, we know what it takes to disrupt a major world industry such as that of petroleum-based transport. So, we do wish that the *New York Times* would recognize that AI for Tesla guidance is a work in progress; that if its recent front-page story is read carefully, the "injured party" could also be guilty of that tragedy; and when compared with other automakers, Tesla's crash rates might not be so newsworthy. The Times "got it wrong" several years ago with a story on Tesla and had to retract its consultant's findings. Perhaps it will have the courage to admit there are two or more sides to its most recent hit on Tesla.

Elon Musk repairing his BMW's broken window in 1995 with parts bought from a junkyard.

Photo credit: Sissi Cao, "Elon Musk's Mom Posts Rare 1995 Photo Showing the Tesla CEO Fixing His First Car," Observer, *12/12/19.*

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MESSAGE FROM ARCHIVES CHAIRMAN DON NIELSON

Don Nielson

If you dig into SRI's past, it doesn't take long to learn that many if not most of its important contributions are destined to lie hidden. Contributing to the early phases of change offers some leverage, but the consequence might not be apparent for a long time, if ever. An article in this issue brings one of those leverage points into view. We're grateful to Paul Masson for giving us an account of how, with SRI's help, NASA came to embrace the privatization of space flight. While the billionaires launch themselves, so to speak, SpaceX exemplifies the ongoing, substantive contributions that the SRI-influenced redirection seeded in NASA decades ago. Beyond those early and direct influences, notice how SRI staff easily moved on to continue guiding and managing the effort under new auspices. This "outflow for continuity" has always been a feature of SRI and the staff whose commitment to project success transcends the Institute. Oh, and don't miss William Grindley's personal and unique picture of SpaceX's founder.

Dramatic changes are in store for SRI itself. Beyond the SRI news about important research in drug discovery and the now critical challenges of online education, there is SRI's announcement about a complete redesign of its campus! You will see the rudiments of the new plan but there is much left to reveal, particularly its implications for the future of the Institute in both derived income and the type of research conducted. More information will be forthcoming, but if you've an urge to respond we have initiated a new reader feature, "Letters to the Newsletter," you are free to use.

Then there was the beauty of Filoli in the spring. A good bunch of you turned out to enjoy it and the company of colleagues. The lunch was delicious, and the event felt open and inviting. Those who worked to make it that way are mentioned just ahead of the Gary Bridges imagery.

Along with the new invited letters section there is one more addition intended to give you some insight into projects and research areas under way at SRI beyond its news releases. The "Ongoing Research at SRI" section will do that, and the first offering is from Patti Schank about how an SRI team investigates the challenges facing many students.

Finally, there is the upcoming annual reunion. The Alumni Steering Committee has again voted to make it free to members. For nonmember alumni who would like to attend, their $25 fee will also become their first year's membership fee in the association. Please put October 21 on your calendar and let us know you are coming! Let's hope that the COVID nightmare will not resurge and interfere. I hope there's none among you informed alumni still unvaccinated.

Thursday
21
October

The Annual Reunion is on October 21, 2021. Please see the announcement on page 17. The invitation flyer for the event is enclosed with this mailing.